

Homework Set 5 Solutions

(Distributed 10/5/16; Due on 10/12/16)

Read Chapter 8 in Zumdahl and complete the listed questions from the text: (8E and 7E) Chapter 8: 29, 33, 38, 42, 46, 55, 58, 70; as well as the following problems:

A. Calculate the molar mass for each of the molecules below:

(i) $\text{Al}_3(\text{PO}_4)_2$
271 g/mole

(ii) $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ (sucrose)
342 g/molr

(iii) $\text{Ca}(\text{HCO}_3)_2$
162 g/mole

(iv) $\text{C}_6\text{H}_{14}\text{N}_2\text{O}_2$ (lysine)
146 g/mole

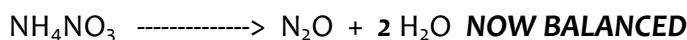
B. Complete the table:

| Substance | Mass, grams | Molecular or formula mass | # moles | # molecules or formula units |
|--|-------------|---------------------------|----------------------|------------------------------|
| MgCl_2 | 21.7 | 95.2 | 0.228 | 1.37×10^{23} |
| K_2Se | 881.9 | 157.2 | 5.61 | 3.38×10^{24} |
| $\text{Ba}_3(\text{PO}_4)_2$ | 19.26 | 601.9 | 0.032 | 1.93×10^{22} |
| $\text{C}_3\text{H}_7\text{O}_2\text{N}$ | 0.074 | 89 | 8.3×10^{-4} | 5×10^{20} |
| $\text{C}_7\text{H}_6(\text{NO}_2)_2$ | 254,860 | 182 | 1400.3 | 8.43×10^{26} |

C. An organic compound used in food flavoring is 40.67% carbon, 5.08 % hydrogen and 54.25 % oxygen. What is the empirical formula for this compound? If its molecular mass is found to be 118 g/mole, what is its molecular formula?

40.67 g C x 1 mole/12 g = 3.39 moles 1 C
5.08 g H x 1 mole/1 g = 5.08 moles 1.5 H
54.25 g O x 1 mole/16 g = 3.39 moles 1 O empirical formula $\text{C}_2\text{H}_3\text{O}_2$
empirical formula weight = 62 so 118 = 62 x 2 so molecular formula = $\text{C}_4\text{H}_6\text{O}_4$

D. Nitrous oxide, or “laughing gas”, is prepared by the thermal decomposition of ammonium nitrate:



Balance the equation and predict how many moles of nitric oxide and moles of water will be prepared from 1 kg of ammonium nitrate

$1 \text{ kg} = 1000 \text{ g} \times 1 \text{ mole}/80 \text{ g} = 12.5 \text{ moles } \text{NH}_4\text{NO}_3$

12.5 moles of NH_4NO_3 would be expected to produce 12.5 moles of N_2O and 25 moles of H_2O .

Problems from Zumdahl:

Chapter 8:

29. (a) BaCl_2 : 208.2 g (b) $\text{Al}(\text{NO}_3)_3$: 213 g (c) FeCl_2 : 126.75 g
(d) SO_2 : 64 g (e) $\text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2$: 158.17 g

33. (a) $41.5 \text{ g} \times 1 \text{ mole}/95.2 \text{ g} = 0.436 \text{ moles}$
(b) $135 \text{ mg} = 0.135 \text{ g} \times 1 \text{ mole}/29.9 \text{ g} = 0.00452 \text{ moles}$
(c) $1.21 \text{ kg} = 1210 \text{ g} \times 1 \text{ mole}/52 \text{ g} = 23.2 \text{ moles}$
(d) $62.5 \text{ g} \times 1 \text{ mole}/98 \text{ g} = 0.637 \text{ moles}$
(e) $42.7 \text{ g} \times 1 \text{ mole}/78 \text{ g} = 0.547 \text{ moles}$
(f) $135 \text{ g} \times 1 \text{ mole}/34 \text{ g} = 3.97 \text{ moles}$

38 (a) 77.6 g (b) 177 g (c) $6.09 \times 10^{-3} \text{ g}$
(d) 0.220 g (e) $1.26 \times 10^3 \text{ g}$ (f) $3.78 \times 10^{-2} \text{ g}$

42 (a) 0.0141 moles S (b) 0.0159 moles S
(c) 0.0258 moles S (d) 0.0254 moles S

46. (a) 80.34% Zn 19.66% O (b) 58.91% Na 41.09% S
(c) 41.68% Mg 54.86% O 3.46% H (d) 5.93% H 94.06% O
(e) 95.2% Cu 4.8% H (f) 83% K 17% O

55 (a) NaO (b) $\text{C}_4\text{H}_3\text{O}_2$ (c) $\text{C}_{12}\text{H}_{12}\text{N}_2\text{O}_3$
(d) $\text{C}_2\text{H}_3\text{Cl}$

58. $11.64 \text{ g N} \times 1 \text{ mole}/14 \text{ g} = 0.83 \text{ moles N}$
 $88.36 \text{ g Cl} \times 1 \text{ mole}/35.5 \text{ g} = 2.49 \text{ moles Cl}$ $2.49/0.83 = 3$ NCl_3

70. Li_3N